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ANNUAL INVESTIGATIVE REPORT FOR 1930

and

PROGRAM FOR 1931

NORTHERN REGION
and
NORTHERN ROCKY MOUNTAIN FOREST EXPERIMENT STATION
MISSOULA, MONTANA

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Investigative Work, R-1
1931

June 19, 1931.

ANNUAL REPORT FOR 1930

and

PROGRAM FOR 1931

of the

REGION I INVESTIGATIVE COUNCIL

For the Investigative Council

EVAN W. KELLEY
Chairman.

Approved June 24, 1931.

R. H. WEIDMAN
Secretary.

EVAN W. KELLEY
Regional Forester.

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ANNUAL REPORT OF THE REGION I INVESTIGATIVE COUNCIL FOR 1930

AND PROGRAM FOR 1931

The annual meeting of representatives of all agencies engaged in forest research in the northern Rocky Mountain region was held this year in the Chamber of Commerce building, Spokane, Washington, on January 9 and 10. The various federal agencies, the forest schools and the private operators were all represented at this meeting and the present report, intended primarily to cover the work of the Experiment Station and other Forest Service offices in the region, also includes the results of the research being done by the other agencies.

PERSONNEL OF THE COUNCIL

Eight forest agencies were represented at this council meeting and the following men attended all or part of the sessions:

U. S. Forest Service: E. W. Kelley, chairman; R. H. Weidman, secretary; Elers Koch, T. Lommasson, M. I. Bradner, D. S. Olson, F. J. Jefferson, H. T. Gisborne, I. T. Haig, M. H. Wolff, and John McLaren.

Forest Schools: Dean T. C. Spaulding, Dr. C. A. Schenck and Professor J. H. Ramskill of the University of Montana; and Dr. E. E. Hubert of the University of Idaho.

Office of Blister Rust Control: S. N. Wyckoff, H. N. Putnam, Kermit Miller, C. C. Strong, and H. R. Offord.

Indian Forest Service: Lee Muck.

Consulting Foresters: D. T. Mason, Mason and Stevens; and N. G. Jacobson, Western Forestry and Conservation Association.

Private Timber Operators: A. A. Segersten, Potlatch Lumber Co.; E. W. Thorpe, Secretary, Timber Products Bureau, Spokane Chamber of Commerce; A. Whisnant, Secretary, Pacific Logging Congress.

Weather Bureau: E. M. Keyser, F. C. Crombie.

Bureau of Entomology: J. C. Evenden.

British Columbia Forest Service: G. P. Melrose.

MATTERS OF GENERAL INVESTIGATIVE POLICY

Extent of Regional Research in 1930

Six agencies reported 120 research projects in progress during the year, as follows: Forest Service, 62; University of Montana, 19; University of Idaho, 18; Bureau of Entomology, 10; Office of Blister

Rust Control, 7; and Weather Bureau, 4.

The total expenditure on regional research in forestry amounted to $128,132. The amounts spent by each agency by lines of work are shown in the accompanying table.

Selection and Designation of Experimental Forests

Definite progress was made during the year in the examination and setting aside of experimental forests in the northern Rocky Mountain region. To begin with, the subregions in which the experimental areas should be located have been reasonably well defined for several years. Six such subregions have been recognized and up to last year suitable areas in four of them had been practically decided upon. Two of these, the Priest River and the Bernice areas, which have been in existence for some years, were definitely recommended during the winter and formally set aside and dedicated to research by the Forester under date of April 8, 1931.

Last summer field examination was made of three proposed areas in the Coeur d'Alene and three in the Clearwater subregions. Previous to last year other proposed areas, to the number of three, had been reconnoitered in these same subregions. The field work last year resulted in finding quite satisfactory areas in both localities. Before either of these areas, or the Coram and Little Trapper Creek areas (Larch-fir and western yellow pine subregions) can be recommended for approval, however, it will be necessary to do additional field work to determine definite information on boundaries required for the formal statement by the Forester which officially describes and designates the areas. It is hoped that boundary location of all four areas can be carried out during the coming field season.

When the above boundary work has been done, six experimental forests will have been selected--three representing different conditions in the western white pine type, and one each in the larch-fir, lodgepole and western yellow pine types. There has been some consideration lately of the need of locating several additional experimental forests. The suggestions are for an additional area in lodgepole pine, one in the Engelmann spruce type represented by the Blackfeet-Flathead territory, and also a small area representing the radically different western yellow pine conditions in southeastern Montana. The plans for the present are to do first the field work in connection with boundary locations on areas already decided upon and later to give attention to the proposed additional areas.

Experimental Ranges

Entirely untouched so far has been the matter of locating experimental ranges in this region. A preliminary discussion last winter between Messrs. Koch, Smith, Wolff, and Weidman tentatively indicated subregions, possible areas and procedure to be followed in reconnoitering and selecting areas. The possibility was discussed of finding an area or two within which both silvicultural and range research objectives could be combined. This would be particularly desirable in the case of the suggested experi-

Expenditures by Lines of Research Work by Different Agencies
Northern Rocky Mountain Region
For Calendar Year 1930

Line of Work	AGENCY						
	Forest Service	Univ. of Idaho	Blister Rust Cont.	Bur. of Entomology	Weather Bureau	Univ. of Montana	Total
Art. Reforestation	998					200	1,198
Influences							
Management	8250	3000				550	11,800
Mensuration	1695	1410				25	3,130
Protection	13260	1204	51880	14000	4600		84,944
Products	11880	4310				270	16,460
Grazing	500					250	750
Ecology	440					40	480
Silvics							
Dendrology							
Economics	4935	500				525	5,960
General and Miscellaneous	2770	640					3,410
TOTAL	44728	11064	51880	14000	4600	1860	128,132

mental forest for western yellow pine on the Custer Forest and for the proposed additional lodgepole pine experimental forest. So far no field work in the location of experimental ranges is definitely planned for the coming field season.

Natural Areas

Activity in connection with natural areas for the preservation of virgin forest conditions was entirely incidental during the last year. Numerous areas have been considered and nine have been tentatively selected in the various forest types of the region. The selection has been largely on the basis of correspondence with Forest Supervisors. Before the areas and their boundaries can be fixed and described as required for formal designation by the Forester, they should be examined in the field to see whether they definitely meet the requirements. Koch and Weidman, who comprise the committee for selecting and recommending natural areas and experimental forests, have for the most part been able to give time to this work only as they could combine these objectives with field trips scheduled for other and more important work.

Need for Increased Funds for Regional Research

On July 1 this year forest research work in this Region will receive its first increase in funds in 10 years. The amount will be $45,000, of which $20,000 will be for starting the forest survey, $15,000 for fire research, and $10,000 for range research at the Ft. Keogh Livestock Experiment Station. To meet the Regional needs adequately and in conformity with the program authorized by the McSweeney-McNary Act, additional funds should be made available during the next fiscal year. As a matter of fact, last year's estimate for increases called for exactly double the amount that is actually to be received July 1 this year. The entire program of work then deemed necessary for starting has the same reasons to support it now as then and the funds to get it under way should, therefore, be provided by July 1, 1932, along with additional money for several new lines of endeavor which should, in the logical development of Regional research, be commenced at that time. The recommended increases by classes of work are listed as follows in order of priority:

Class of Work	Recommended Increase effective July 1, 1932
Silvicultural studies	$20,000
Range research	25,000
Forest survey	15,000
Forest economics	5,000
Biological research	10,000
Erosion and streamflow studies	15,000

Silvicultural Studies

The recommended increase of $20,000 is for projects dealing with methods of cutting, slash disposal and yields of western white pine

forests and for preliminary studies of the same nature in the larch-fir forests.

The western white pine is one of the most valuable species in the United States. Sales have been made from the National Forests at stumpage prices of nearly $12 per M board feet, as compared with $1 to $3 for other species with which it is associated. About a third of the total lumber cut in the Northern Rocky Mountain region is of this species. The management problems of the white pine forests are among the most complex of the country. The number of competing species is large and they are more aggressive in reproducing themselves than the pine. An enormous amount of slash is left on the ground in cutting, which sometimes prevents the seed from germinating and in all cases creates a serious fire hazard. Broadcast burning of slash destroys the young growth and often creates conditions which prevent seedling establishment; piling and burning may cost as much as $35 per acre. Difficulties are enormously increased by the recent invasion of the white pine blister rust.

The larch-fir forest comprises the largest forest type in area in the Region and furnishes the greatest part of the lumber cut of Montana. Preliminary studies to indicate proper methods of cutting and regeneration and the yields to be expected are needed for National Forest and private timber operations. Nothing is being done in larch-fir forests now.

Silvicultural work for the fiscal year 1931, on which expenditures are to be approximately $13,000 will be confined to the northern portion of the white pine region, to the National Forests, and deals largely with restricted phases of methods of cutting and natural reforestation. It is proposed with the increase to do the following:

(1) To extend the work on methods of cutting and natural reforestation to the southern portion of the white pine region and to privately owned lands on which conditions are different;

(2) To take up the question of white pine slash disposal on which the Experiment Station is doing nothing at present;

(3) To enlarge studies of growth and yields in white pine where expenditures are now less than $1,000 annually; and

(4) To conduct preliminary studies in the larch-fir forests as needed and as called for by current problems in National Forest and private cutting.

(5) To adequately undertake the working up of material in the files and now being accumulated. The Station has never had money for computing clerks and as a result, office work is still behind field work and the preparation and publication of results has always been long and seriously delayed.

Range Research

The increase of $25,000 is requested for investigation of grazing problems in the mountain ranges within and adjacent to the National Forests in the Region.

The $10,000 granted last year is solely for investigation of short grass ranges. This work is to be restricted to a portion of the Northern Great Plains, centered at and conducted in co-operation with the U. S. Livestock Experiment Station at Miles City, Montana. Activities there will be in co-operation with the Bureau of Animal Industry and the Montana Agricultural College.

The investigations provided for by the proposed increase will include the remaining major part of the region, where no work is now being done. These ranges support more than 1,000,000 sheep and 250,000 cattle during the summer grazing season, providing an annual income of $6,000,000 and representing an investment of $50,000,000 in land and livestock. Montana as a whole occupies fourth place in the country from the standpoint of cattle production.

Substantial reduction of grazing capacity in these mountain ranges and lessening of the weights of the stock grazed have resulted in decreased income. This has been due to faulty range management because of lack of definite information on how ranges should be managed in order to maintain their crop capacity. The determination of means of restoring depleted ranges to full producing condition and of the methods necessary to maintain full production is of vital importance in insuring a stable income to livestock producers and in maintaining the watershed cover.

The work in the mountain ranges east of the Continental Divide will require the investigative activities of three men and the problems involved in developing the ranges of western Montana and northern Idaho to take care of the ever increasing bands of sheep shipped in from eastern Washington will require the efforts of two men.

Forest Survey

The $20,000 granted last year is barely sufficient to get the inventory phase of the Survey under way. The increase of $15,000 recommended for July 1, 1932, is for starting the equally important aspects of the Survey dealing with growth and drain.

The economic welfare of the Region is largely based upon forest industries and the most valuable forest resources in private ownership, such as the western white pine, western yellow pine, and cedar are rapidly being depleted by cutting. Disastrous forest fires and the threat of white pine blister rust are contributing factors in the matter of depletion. Slash fires which prevent regrowth on cut-over lands also enter into the problem. The situation involves complex public and private owner relationships. It presents one of the very puzzling forest problems of the country. Investigation of all phases of the subject should be undertaken as soon as possible in order to obtain basic data necessary for effectively working out public and industrial forest policies which will enable perpetuation of the resources and the industries. The situation in the Region is such that this work should be done at once.

Forest Economics

A $5,000 increase is recommended for research in the financial aspects of timber growing in western white pine and western yellow pine forests.

The western white pine forests contain the highly prized white pine and cedar, but along with them a number of other species in mixture which have a very low or negative market value. Many private timber owners might be induced to practice a desirable type of selective logging and careful slash disposal with a view to holding their residual timber for a second cut, if the problem could be adequately investigated with a view to analyzing the economic aspects of logging, manufacture, protection and taxation along with the silvicultural features. A rapid rate of growth takes place in the white pine forests and much of the private timber land has a relatively high timber producing capacity.

Biological Research

A $10,000 increase is proposed for investigations of wild life and its relationship to forest and range conditions. Two phases of this work are involved: one dealing with game animals and their place among the forest resources of the Region; and one dealing with rodents and lesser fauna which exert an important and often critical influence upon seed supplies and regeneration in the forest and upon grasses and other forage on range lands.

No work of this character is provided for by McSweeney-McNary funds in this Region at the present time. In order to attack one of the more urgent game problems, however, and purely as a temporary measure which may not continue beyond the present year, the Forest Service and the Game Department of Montana are co-operatively financing a forest officer in a study of elk problems in Yellowstone National Park and adjacent National Forests. Both the Park Service and the Biological Survey also co-operate in this project.

The Northern Rocky Mountain region is the largest remaining area of big game in the country. Deer, elk, moose, bighorn sheep, mountain goat, black and grizzly bear are still fairly plentiful. They are an important regional and national asset, not only from the standpoint of recreation and sportsmanship, but from the standpoint of preserving as a national heritage the wild life conditions which have been an intimate part of American frontier history from the days of Daniel Boone to the trail blazers of the West. The elk and in some cases other animals are now in conflict with livestock in the use of summer and winter rangos and are beginning to lose out in the struggle. The situation is very critical in the case of the elk and is a growing one in the case of deer. In this connection, the Forest Service has been besieged by one of the most influential sportsmen's organizations in the country to close the entire Lewis & Clark Forest to grazing of livestock. The Regional Forester considers the conflicting use of range by livestock and game animals as a very urgent problem about which something very definitely must be done in the near future. All of the game animals, but particularly the deer and elk, suffer serious losses from coyotes, cougars and other predatory animals. Adjustment and balance of wild life conditions is urgent and possible of attainment if provision is made for adequately studying the problems involved.

Rodents are a very important factor in reducing the available seed supply and thus contributing, along with such factors as infrequent seed years and dry summers, to the difficulties of establishing reproduction promptly after logging and forest fires. This is an acute problem in western yellow pine forests and is also important in white pine timber. Pocket gophers do serious damage to forest plantations. Gophers and ground squirrels are the cause of untold destruction of range resources.

Erosion and Streamflow Studies

A $15,000 increase is needed for investigations of erosion and silting of streams constituting the headwaters of the Missouri River in eastern Montana.

The drainage of the Upper Missouri, including the Yellowstone, Musselshell, Milk, Marias, Sun, Tongue, Bighorn, and other rivers and their numerous tributaries, carries immense loads of silt to the Missouri each year. This represents the eroded top soil of the plains, breaks, and foothills which is removed both by sheet erosion and by gullying. Gully erosion is particularly serious in the breaks country. Wind erosion is also a serious factor. A vast territory in eastern Montana is affected. The bulk of it is range land which obviously has an increasingly low stock carrying capacity due to the contributory influence of unrestricted grazing in preventing revegetation and fixing of the soil. Moreover, more than three million acres of the region is in abandoned dry farm lands where the situation sorely calls for re-establishment of plant cover. Important irrigation projects like Sun River, Milk River, Valier and others are dependent on clean water to prevent silting of the dams. Outside of these projects nearly every stream of any size in eastern Montana is used for irrigation. Soil and water are of first importance in this territory and much of both is being sacrificed each year.

This is the situation within the region. Outside, the influence of this erosion is that it enormously contributes to the silt load of the lower Missouri and Mississippi Rivers. Erosion research in the Badlands and other sections along the Missouri just outside Montana will be of little avail in this respect if study of the erosion in over a hundred thousand square miles of the headwaters region is neglected.

No work is now being done in this important field of research. If federal work is undertaken co-operation can be expected from the Montana Extension Service and Montana State College.

PROJECTS UNDER WAY OR PLANNED

The Council discussed each of the following lines of work in detail placing emphasis and confining discussion as far as possible to results, new work and correlation of efforts.

Artificial Reforestation

The year just closed has been a productive one from the standpoint of publication of results of past research dealing with artificial reforestation. Four contributions to the subject have made their appearance

including Mr. Olson's Department Circular, "Growing Trees for Forest Planting in Montana and Idaho," and three articles by Mr. Wahlenberg completing the series of reports covering back work. The planting investigations now under way in the Region are being carried administratively by the Office of Planting and the Forest Schools. The Regional Office feels that this work is adequate for the present needs, except for a problem of heavy losses of stock through an unexplained disease which has been active for several years at Savenac Nursery. In 1930 there was a loss of nearly one million white pine principally in the 1-0 seedling age class but with substantial amounts in the older age classes as well. It is felt that the situation is serious enough to need the service of a plant pathologist at the Nursery for a period to determine its cause and formulate remedial treatment.

Nursery Practice

The usual amount of work on amount of seed to sow, fertilizing, and study of broadcast versus drill sowing was carried through the 1930 season. There is nothing new to report on this work.

Dean Spaulding, however, reporting on experiments in nursery practice conducted at the University of Montana School of Forestry states that as a result of these experiments, it is now possible to produce plantable stock for several hardwood species commonly used in farm windbreaks in one year instead of two as formerly required.

Sowing and Planting

Dr. Hubert reported that as a result of a study conducted by the University of Idaho School of Forestry, it is now possible to point out for southern Idaho the beneficial results of windbreaks on the yield of field and orchard crops, a hitherto disputed point in some sections. A report on this study is now being prepared for publication. Two other planting studies underway at Idaho, one dealing with planting in alkali soils and the other with planting at high elevations, need to run several years longer before definite conclusions can be drawn. Preliminary results, however, show the beneficial effects of a sand back-fill in planting trees on alkali soils, and the much better survival of hardwoods as compared with conifers on both alkali soils and at higher elevations.

A new project in this general field, a spacing study in western yellow pine using 6x6, 8x8, and 10x10 foot spacing in contiguous plots on identical site conditions, was started during the past year by the Office of Planting. A plot with 15x15 foot spacing is to be added, as well as a similar set of plots of western white pine, as soon as a suitable site is found. This experiment is the direct result of the desire of the Investigative Council, as described in the 1929 report, to have established planting plots with various spacing to check the suitability of the 8x8 spacing now extensively employed in the region.

The study of survival of planting stock on grassy bottom lands continued inactive.

Seed Studies

Mr. Olson reported that being forewarned of the excellent seed crop last fall, it was possible to gather valuable data on cone collection and seed extraction for all of the important species of the region. It has been found that white pine cones collected before August 15 do not open when dry and that cones of other species gathered before this date open slowly and only partially when dry. In addition, cutting tests and the weights of the sample indicate that the seeds of early collection are mostly hollow. All cones seem to be in best condition for collection and extraction the first week in September. Germination tests are now being run to give supplementary and more accurate data on some of these points.

Tests are also being made to determine the germinative capacity of western yellow and western white pine seed from various age classes, particularly from very young stands. Regional Forester Kelley pointed out the importance of this work in determining the role played by young trees in reproducing burns. Many 1910 burns, for example, bear a scattered stand of young trees which came in immediately after the fire. These trees are now beginning to bear cones and if the seed is fertile will aid materially in hastening the restocking of such areas. Apparently good cones have been found on 16-year-old yellow pine, 18-year-old cedar, 10-year-old white pine and 19-year-old spruce. White pines usually bear only three or four cones the first crop but the yield increases rapidly up to an age of 45 years. After that, the yield is only slightly more and the cones are all borne at the top of the crown even if the trees are open grown. There is a striking difference between the yield of the western white and western yellow pines. Two pounds of seed is a heavy yield from a mature white pine tree, while in exceptional cases, mature yellow pines may bear as much as 60 pounds of seed.

A new study of local climatic races of Englemann spruce promises to be both interesting and profitable. In the nursery spruce often suffers severely from frost injury, so much so as to retard new growth and necessitate keeping the injured 75 per cent of the spruce seedlings in the nursery a year or two longer than the uninjured plants. Frost injury in spruce plantations is also common. Accordingly a study is being made of the relative frost hardiness of spruce from various elevations and localities. Seed has been collected from elevations ranging from 3000 to 7000 feet and on both sides of the Continental Divide. The stock grown from each lot will be followed in both the nursery and the field and an attempt made to select local climatic races that will give a minimum of frost injury under both nursery and field conditions.

Forest Influences

No projects are listed in this general field for the northern Rocky Mountain region. But undoubtedly a number of studies now underway, for example the measurement of a number of climatic factors under full timbered, half timbered and clear-cut areas, part of one of the fire studies, will undoubtedly contribute to our knowledge of forest influences. No work is proposed in this field.

Forest Management

There are seven continuing projects in this field, of which three yielded tangible results in 1930.

Methods of Cutting

One of the major projects deals with the determination of suitable methods of cutting in the western white pine type to secure satisfactory reproduction of the desired species and the best development of residual stands. As previously reported the field work on one phase of this study, a transect study of old cuttings, has been finished. Complete results from this work are not yet available and must await careful analysis of the records of individual cuttings.

Some interesting preliminary results on the growth of residual trees are available from the transect study. In the Annual Investigative Report for 1929, Mr. Koch described in some detail the need for more information on the rate of growth after cutting on mixed species and white pine in those stands which are not cut clean. The transect study will supply a good deal of information of this sort. Preliminary figures now available show, for example, that the average white pine left after logging grows at the rate of about one inch per decade. This statement is based on increment borings from 1102 trees taken on 158 sample plots scattered over twenty cut-over areas in various parts of the region. This growth is only about one-third to one-half again as fast as on similar trees before cutting so that compared with some other pines, such as western yellow, white pine does not accelerate particularly well after release. About 80 per cent of the white pines left do accelerate to some extent. Rate of growth as well as degree of acceleration vary markedly with a number of factors such as locality, degree of liberation and crown health.

Variation in growth with locality is shown in the following table:

Location	Average Diameter Growth After Logging	Basis Number of Trees
	Inches	
Pend Oreille	0.7	264
Coeur d'Alene	0.9	394
Kaniksu	1.1	60
St. Joe-Palouse	1.5	384

The Kaniksu and Pend Oreille figures are not entirely dependable due to localizing of data, but between the soil and climatic variations of the northern part of the type and the southern part represented by the St. Joe-Palous section there is undoubtedly a distinct difference in rate of growth.

Liberation or degree of release is also an important factor. Trees with excellent liberation grow on the average about twice as fast as trees with poor liberation. Crown health, however, is the most

important factor of all. The growth of trees with good crowns is usually two to three times that of trees with poor crowns. On the Coeur d'Alene the average white pine with a good crown will make about 1.1 inch per decade. The average white pine with the poor crown will make only 0.6 inch per decade. If the tree with a good crown holds its advantage for two decades, it will contain at the end of that time between 65 and 125 board feet more than its rival. Crown health usually outweighs other factors. The average residual white fir with a good crown on the St. Joe-Palouse areas will grow about 1.8 inches per decade with excellent liberation and 1.4 inches with poor liberation. Trees with poor crowns but excellent liberation make only 1.0 inch per decade. It obviously pays to leave trees with good crowns, even if poorly liberated, in preference to trees with poor crowns even with excellent liberation.

These findings have direct practical value. They indicate clearly that it is worth taking the time to select the trees to leave. Other things being equal, the tree with a regular, well-filled crown of normal green color is a good tree to leave; the tree with a straggly crown of sickly needles is obviously a tree to cut.

This study also furnishes some preliminary information on the loss of residual trees through death and windfall. A study of conditions on some twenty timber sale areas, containing a total of 1152 residual white pines on the sample areas measured, shows that on the average about one out of five of the smaller trees (under 14 inches) and one out of six of the larger trees of seed tree size (over 14") dies or blows down in the first 15 years following logging. Most of this loss seems to be due to death rather than windfall, though the nature of the transect study makes it impossible to separate these factors with accuracy. While nothing is known about further loss after the first 15-year period, it is generally conceded that most of the loss comes immediately after logging, and that the loss after the first 15 years will be small.

The preliminary results given are indicative of what will be obtained in a comprehensive analysis of the transect study material. It is hoped to complete this analysis during the coming year.

The Experiment Station now has a total of twenty permanent plots being used in the methods of cutting study. Most of these are just approaching five years old and are therefore still too young to warrant a thorough-going analysis of reproduction records. Preliminary compilations, however, indicate that most of our timber sale cuttings are reproducing satisfactorily, but the data do not yet give concrete evidence as to why this reproduction is more satisfactory on some areas than on others. The plot records do emphasize, however, that silvicultural problems vary considerably by locality and age class and that conclusions drawn from experiments in one locality or age class may not be applicable in another. To illustrate briefly, the amounts of reproduction from seed shed by seed trees is relatively light on the Kaniksu and relatively heavy on the Coeur d'Alene, the reason, tentatively being a much greater destruction of seed by weevil and squirrels on the Kaniksu. Two investigators working independently in these two localities might quite readily draw different conclusions as to the value of seed trees. Each would be

correct in his own locality but wrong for the other locality. Conditions differ by age class in similar manner and there is no doubt that to correctly solve regional problems our present series of permanent plots is very important and must be greatly expanded. At present, the funds available for management studies are barely sufficient to carry the routine examinations of the plots now in existence.

Methods of Reproduction

The Experiment Station project under this head includes both temporary and permanent plot experiments aimed at solving the problems of seed production, distribution and germination, and seedling survival on burns and logged areas. These experiments are now beginning to yield interesting evidence on some of these points, particularly as to source of seed. This has always proved an interesting and difficult problem. It was thought by the first investigators and observers in the region that long distance seeding played the major role in reproducing western white pine forests, particularly in regenerating large single burns. Later, stored seed was regarded as the main source of supply. The permanent plots now being examined indicate the relative importance of two other somewhat neglected sources, namely, current or coincident seeding, as from cone bearing trees killed by the fire but shedding seed on the ashes, and subsequent seeding, as from seed trees or trees on burns which escaped immediate death by fire even though these trees may succumb some years later to fire injuries and insect attack.

Perhaps the outstanding fact among these preliminary findings is the variety of sources from which the seed comes and the manner in which one source may be dominant in one case, merely contributory in another, entirely subordinate or completely lacking in a third. For example, current seeding, i.e., seed shed from cone bearing trees killed by the fire, had been the dominant factor in reproducing the 1926 burn. But this source would, of course, be totally lacking on areas burnt over in years without a seed crop. Then stored seed has undoubtedly played a part in regenerating some of the cut-over areas being studied, and subsequent seeding has also played a part, sometimes a dominant part, in the reproduction of still other areas. In general, stored seed seems to play a less important role, and current and subsequent seeding a more important role, than heretofore supposed. One interesting fact brought out by the permanent plots is that reproduction from stored seed will all come up within the two years following logging. Any reproduction coming in after that time is assuredly from some other source.

Two of the permanent experiments on the program give additional interesting information on the source of seed problem. First, experiments in which seed has been stored naturally in the duff, which are now in their third year, indicate that white pine seed is the only kind of seed (with the possible exception of lowland white fir) to remain viable to any extent after one year's storage in the duff under natural conditions. This is shown in the following table:

Percentage of Viable Seed After Natural Storage

Under Virgin Timber

Period of Storage - Years	Western White Pine		Other Species				
	Larsen's Tests '21 to '25	Knoll Plot Tests '27 to '29	Knoll Plot Tests '27 to '29				
			Eng. Spruce	Doug. Fir	Cedar	White Fir	Larch
0	No record	41.3	38.2	21	15.3	No record	No record
1	20	42.2	0.6	0.1	0.0	"	0.3
2	1	10.0	0.1	0.0	0.0	0.0	0.0
3	33						
4	0						
5	0						

Second, an experiment in fire girdling western white pines shows that cone bearing trees killed at the ground by fire will produce viable seed by the time the cones open in the fall.

Percentage of Viable Seed

Trees Fire-killed		Normal Trees (Check)
June, 1929	July, 1929	
30.7%	37.4%	54.2%

The normal trees, however, seem to produce a greater amount of viable seed and apparently the later in the season a tree is fire-killed, the better chance it has of producing a normal crop. But cone bearing western white pine trees killed even as early as June will mature considerable amounts of seed.

Some preliminary figures are also available on seedling survival. This information is given in the following tables:

Percentage of 1927 Western White Pine Seedlings Dead by Years

Year	Percentage Dead	Character of Season
1927	13	Moist
1928	22	Dry
1929	9	Extremely dry
1930	5	Very dry

Percentage of 1927 Seedlings

Surviving in Fall, 1930

Species	Per Cent
L. W. Fir	71
D. Fir	63
W. Larch	56
W. W. Pine	51
W. Hemlock	27
W. R. Cedar	24

These figures are only tentative and will undoubtedly be changed somewhat by the inclusion of more data. It is clear, however, that most seedling deaths will come in the first two years after germination and that from the third year on death from normal causes, other than competition, will be negligible. It also seems safe to say that for western white pine one out of two or, conservatively, one out of three seedlings will survive at least the early seedling stages and that any white pine seedling a foot or over in height may be safely considered as established for it is quite sure to be over three years of age. Information on this point has been heretofore completely lacking.

Brush Disposal

The only active project in this important field is conducted by the University of Idaho. The study has evolved along two lines. First, the development of a torch or burner capable of igniting one to two year old slash independent of weather conditions, thus eliminating the necessity of burning slash when it is not perfectly safe to do so. This work has now progressed to the point where the Hauck Manufacturing Company is ready to build a burner incorporating all of the principles evolved and to place it on the market as a modification of the Standard burner. Excessive carbonation is the last obstacle to be overcome.

The other phase of the problem has involved a study of slash disposal in over-mature western white pine stands containing a great deal of valueless and decadent mixed species. A method of restricted slash burning has been developed in which the worthless residual trees are felled and disposed of along with the logging debris in such a manner as to conserve whatever seed trees may have been retained. This method is roughly about one-third as expensive as piling and burning.

Thinning

No progress except the periodic remeasurement of two plots in 1930.

Mensuration

Very little progress was made in this field during the past year. As stated in the 1929 report the western white pine yield study conducted by the Experiment Station has produced complete yield, stand and volume

tables for second growth western white pine. The manuscript presenting these tables and accompanying text will be submitted for publication by summer. No progress has been made on the application study which should follow, and there is no prospect of this work being undertaken until an increase of Station funds for silvicultural research permits the assignment of a staff man to this job.

Seven permanent yield plots, four white pine, two Douglas fir and one red cedar plot, and twenty-three semi-permanent yield plots in white pine stands, were given their first five-year remeasurement in 1930. The semi-permanent plots, of which there are 58 in all, are an interesting and promising innovation in our permanent plot system. They were first installed as temporary plots in 1925 and 1926 in the course of the normal yield study. The boundary of each plot was carefully blazed and one corner post set and tied in to some convenient land mark. Individual trees are not tagged as on permanent plots. But as such plots are inexpensive to install and easy to remeasure, they should prove of considerable value in supplanting our skeleton series of standard permanent plots on which trees are tagged and measurements taken and kept in detail for individual trees.

The remaining projects in this field of which the Experiment Station carries six, the Office of Management and the University of Idaho three each, and the University of Montana two, are for the most part either inactive or continuing projects requiring only incidental or periodic attention. Mr. White's transfer to other work has made it impossible to do very much investigative work during 1930 on the Office of Management projects. The Experiment Station may be asked to compile some of the data taken in the increment studies of that office.

One very interesting project, however, was undertaken jointly by the Office of Products and the Office of Management. This was an increment study of a second cut operation conducted by the lumber department of the Anaconda Copper Mining Company. The operation involved relogging over a thousand acres of western yellow pine timberland in the vicinity of Greenough, Montana, originally cut over lightly some 40 years ago by the Big Blackfoot Milling Company. A cut of from four to six thousand board feet per acre was realized. In numerous places the old stumps and tops were sufficiently well preserved to permit accurate measurement of stand conditions in 1888, the time of the original cutting. In 1888 numerous trees 14 inches and under in size were left in addition to limby or otherwise undesirable trees of larger size. In 1927, the date of relogging, any 12-inch tree that would make one straight and smooth log with a 6-inch top was cut. An understory stand of second growth was left after this operation, including some dominant young trees as large as six to eleven inches in diameter.

The data recorded will yield information on the amount and character of material logged at each date, the increment by tree sizes and a comparison of utilization practices in 1888 versus 1927. The economics of carrying this land from 1888 to the present time will also be analyzed and a prediction made of the future growth on this area in the next forty years.

The analyses to date disclose some interesting changes in utilization practices in the last forty years. Merchantable lengths and top utilization diameters in the old days reflect with emphasis the "high grading" practices prevailing at that time. The following tabulation shows a comparison of these variables by tree diameters for western yellow pine:

WESTERN YELLOW PINE

D.B.H. Ins.	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
Merchantable Tree Length Feet															
1888	-	24	30	34	36	38	38	40	40	42	42	42	44	44	44
1927	30	38	46	50	46	60	62	66	68	70	72	72	74	74	76
Dif.	-	14	16	16	20	22	24	26	28	28	30	30	30	30	32
Top Diam. Av. Tree, Ins.															
1888	-	7.1	8.9	10.9	12.6	13.8	15.0	16.0	17.0	18.2	19.5	21.1	22.7	24.6	26.9
1927	5.5	6.6	7.3	7.8	8.3	8.8	9.4	10.0	10.6	11.6	12.8	14.2	15.8	17.8	20.1
Dif.	-	.5	1.6	3.1	4.3	5.0	5.6	6.0	6.4	6.6	6.7	6.9	6.9	6.8	6.8

The presentation of this project at the Council Meeting was followed by a lively discussion, which clearly emphasized the interest and importance of studies of this sort and the desirability of more work of this character. The Council discussed at some length the possibility of carrying on growth studies with administrative forest officers particularly during the winter when other work is less pressing. Some of the Council felt that winter work of this sort would be too difficult and possibly inaccurate. But the general feeling of the Council seemed to be that more of it could be done if it were given recognized priority particularly in mild and favorable winter weather. It was stated that ten days or so of field work of this sort will provide data for a month or more of office work. The Regional Forester expressed the feeling that this type of work would be excellent for administrative research and well worth the effort necessary to organize it. Several administrative projects are to be proposed for next winter.

Protection

This is by far the largest field of research in the Northern Rocky Mountain Region. About two-thirds of the research funds expended in the region are devoted to research in forest protection against disease, fire and insects.

Diseases (Blister Rust)

Mr. Wyckoff reported that the investigative and experimental work of the Office of Blister Rust Control continued in 1930 along two general lines of investigation (1) development and improvement of Ribes eradication methods, and (2) field studies of the rust.

Continuing field studies on methods of stream type Ribes eradication have resulted in improvements of both apparatus and working methods. Recent laboratory results have shown distinct possibilities in stem injection and crown injection methods of killing Ribes as contrasted with the spraying methods now in use. This opens up new fields of experimentation on both the Ribes themselves and the method and apparatus for their application. Both chemical investigations and methods experiments are planned to develop these new possibilities. Mr. Offord, who conducts the chemical investigations, explained in detail the interesting and fundamental investigations now under way to develop a suitable toxic chemical by which all Ribes occurring in the white pine belt may be economically and effectually eradicated. Such a chemical and its method of application must be non-hazardous within the limits of field work. Experiments made in 1929 proved conclusively the toxicity of simple chlorate and hygroscopic chlorates to R. potiolore. But R. inerme and R. lacustre continued to exhibit the previously reported high degree of tolerance toward all chemicals tested as sprays. Laboratory investigations of differences in physiology and morphology among these species suggested the following chemicals and methods of eradication for resistant Ribes, (1) the use of buffered chlorate solutions applied as a spray; (2) the use of oils of high penetrability as a carrier of a solution of a soluble organic toxin, preferably a complex salt of a heavy metal; and (3) the use of a complex salt of a heavy metal injected into holes or incisions in the crown or stem. Preliminary results speak favorably for the use of a copper cyanide-sodium thiosulphate complex when injected into a slit in the stem tissue. This compound gives a good top kill even though injected into only one top stalk. Whether or not it will give a root kill is yet to be determined.

Attention is also being given to the permanent suppression of Ribes in the stream type, the ultimate objective being to permanently replace the stream bottom brush type with a turf or coniferous cover. Thus far only turf establishment has been attempted. Several methods which have been or will be attempted include killing the brush with toxic chemicals, spraying the brush with chemicals or oil followed by burning, and cutting, piling and burning the brush. All of these are to be followed by sowing to clover, timothy and other grasses in the following spring. Experiments will also be made in which the brush is cleared, piled and burned and the soil plowed up preparatory to sowing grass or hay, with the use of heavy road machinery. The possibility of using sheep or goats to prevent brush encroachment was also suggested.

The probability that stream type Ribes eradication will be completed in certain areas within the next year, and that the rust will be rapidly intensified in the white pine belt in the next few years, makes it necessary to turn again to large scale experiments upon methods of upland type Ribes eradication during 1931. New work is also being started on permanent plots which will definitely inform us as to the degree of infection and consequent damage to be expected from given amounts of Ribes. By this means we shall secure a measuring stick with which to determine the degree of efficiency which Ribes eradication must attain in order to actually control the rust.

Dr. Schenck mentioned several blister rust resistant pines. At the request of the Experiment Station, seed of one of these, Pinus peuce, was secured several years ago and planting stock is now being grown at Savenac Nursery and some will be planted in blister rust infected areas to test its resistance under local conditions. Experimental planting plots of this species are to be established by the Experiment Station and the Office of Planting to determine growth, yield and adaptability to this region. The possibility of finding a blister rust resistant race of P. monticola was also discussed.

Dr. Hubert described the germination studies of Ribes seed now being carried on co-operatively by the University of Idaho and the Office of Blister Rust Control. Tests of 10,000 seeds of five species of Ribes were made in 1929-1930. The alternation of temperatures from 20 to 50 degrees Centigrade and from 25 to 50 degrees Centigrade were found most effective in stimulating germination. The neutral plot was found more favorable than the acid plot in this respect.

Disease (Rot producing)

One co-operative project carried by the University of Idaho and the Forest Service, dealing with the cull rot in standing timber, and three projects on the decay and sap stains of native woods carried by the University of Idaho, are the only studies now under way in this large and important field. It was the opinion of the Council that, regrettable as this is, the situation cannot be remedied without the allotment of funds badly needed in other fields or without an increase in funds directly appropriated for such studies.

The study of cull rot in standing timber was inactive during 1930 for lack of funds. Progress reports covering this work have been issued. Further work on these studies are urgently needed in view of the future crops of secondary species which may develop on white pine lands where the white pine timber present does not warrant protection from the blister rust. But no funds are available for this work.

A number of reports on various phases of the other three projects conducted by the University of Idaho have already been published. All of these projects are continuing and investigations on new phases are now underway. One of the interesting features on this work has been the isolation of fungi causing brown rots and sap stains in lumber and other wood products. More than 17 different fungi were isolated as causing different types of blue stain alone. Contrary to accepted belief laboratory tests show that the presence of blue stain in the sapwood of western white and western yellow pine does not reduce the resistance of these woods to decay. Controlled tests using clear, medium and heavily stained test sticks showed an average loss in weight of 14.8 per cent for the heavily blued and 15.1 per cent for the clear unstained wood.

Fire

During the past year an important change has been made in the character of the Experiment Station effort devoted to fire research. The

three projects previously carried have been continued but on a diminished scale, and about one-third of the fire research effort has been devoted to a new project. This new work involves the statistical analysis of the Region I fire records to determine the speed and strength of attack necessary to attain successful fire control in each important timber and fuel type for the Region. The work is planned along the lines developed by Show and Kotok in California. Data on the speed and strength of attack needed to produce satisfactory protection are fundamental to adequate fire control and essential in any comparison of the financial needs of one Region with those of another. This was brought out very clearly at the 1930 Washington Conference of Regional Foresters. Data of this sort will also be invaluable in the transportation and organization study now being conducted by the Regional Office to provide plans for the proper distribution and abundance of roads, trails and men.

In addition to this new work the three projects reported regularly in the past were carried forward successfully. The work devoted to weather and fuel relationships was greatly improved by the addition of considerable physical equipment and the installation of three new stations at Priest River for measuring the fuels and weather elements on representative clear-cut, half-timbered, and full-timbered areas. All three stations are now located within a short distance of each other on a large flat with entirely comparable conditions except for the density of forest cover.

Recording duff and air thermographs are among the newly added equipment on each site and the past season's records made by these instruments give some remarkable information on the great importance of shade in holding down surface temperatures, and hence in maintaining higher fuel moisture contents. These instruments recorded on some days, for example, many hours of surface temperatures of over 130°F. on the clear-cut area while the maximum under half shade reached only 100°F., and under full timber only about 87°F., the latter often lower than the temperature of the air in the same locality. As evaporation of moisture from fuels is more than twice as rapid at 130° as at 100°, the shade of remaining trees on a logged-over area is obviously of great importance in reducing fire danger. Furthermore, the higher temperatures found on the clear-cut area, i.e., sustained temperatures of over 130°F., are recognized as dangerous to both ungerminated seed and seedlings. Data on the influence of shade on surface temperatures, therefore, is valuable to both fire and silvical studies alike.

The work on the study of lightning and forest fires continued without much change, the Regional Office helping materially as usual by contributing a qualified ranger to code the 1930 reports. A report covering this work from 1924 to 1928, inclusive, has been submitted for publication.

In the co-operative fire weather project, the Forest Service continued, as during the previous year, to report daily measurements to the Spokane Office of the Weather Bureau. Beyond a doubt, this work has aided materially in improving the accuracy of the local forecasts.

The increase in fire research funds to become effective July 1, 1931, will permit desirable expansion in a number of fields. The exact details of expansion have not yet been worked out but one man will probably be assigned to a fire damage study, one to carrying the fire studies now underway, and one to the new statistical study previously described. This arrangement will permit one man to compile and analyze the five-year records now available in the weather and fuel relationship study, a very desirable piece of work. And the assignment of one full-time man to the statistical study will enable desirable progress on this work with possible expansion at some later date to an analysis of State and Association records if such procedure seems desirable.

Among the research projects carried by the Regional Office of Operation, the development of portable radio telephones for field use continues to be the study of major importance. The purpose is to build readily portable radio sending and receiving sets that can be used to supplement, and in some cases take the place of, the grounded line telephone system now in use on the National Forests and to find and develop radio directing apparatus that can be used by men searching for obscure fires. Both portable and central station instruments have been developed which give encouraging but not entirely satisfactory results under field conditions. Further work during the coming year will be directed toward improvement of performance of the central radiophone station, further elimination of interference noises, and solution of problems relating to the volume of traffic the system will handle. Forest Inspector, D. L. Beatty, will continue to devote full time to the project during the coming year with such contributed help as may seem desirable. The Council displayed a great deal of interest in this project and felt that Mr. Beatty should be invited to the next Council meeting to discuss it in person.

The Office of Operation carries five other projects, one on aerial mapping, one on adequate fire control from an economic standpoint, two on tests and improvement of equipment and one minor project on the relation of lightning fires to underlying geological formations. These are all continuing projects and no definite results are ready for discussion at this time.

The Council displayed marked interest in the discussion of possibilities of using heavy machinery in fire control. The Roto-Tiller was mentioned as being used satisfactorily in Region 6. Dean Spaulding reported that a heavy tractor and Russell grader with a 5 to 8-man crew were found capable, under suitable conditions, of building more line than a 50-man crew working by hand methods. Jacobson reported that the Killifer plow has been used successfully in the Bend territory. Spaulding and Jacobson agreed that when machine equipment is usable it is possible to average about one and one-half miles of line per hour. The Regional study of the use of tractors in fire line construction is to continue.

The Council felt that the study of lightning storms in relation to geologic formations should also be carried to completion since only a very small sum will do this satisfactorily. The Operation study of adequate fire control will probably be absorbed by the new studies to be initiated under the expanded Experiment Station program. The project of aerial mapping

was also discussed, and the Council felt that Mr. Yule should be invited to the next meeting to discuss the map making features in more detail. The development of the multiple lens camera has reduced the difficulties in this field very materially and air mapping seems to have remarkable possibilities. Mr. Melrose reported that the Ontario and Dominion Forest Services have successfully completed very large amounts of aerial mapping.

The Spokane Office of the Weather Bureau continued its studies on lightning storms and fire weather. A seasonal summary of weather conditions during 1930 from a fire weather standpoint has already been completed. A special study was also made of the weather conditions during August, 1929, particularly of individual days when going fires made the greatest headway. A preliminary report on the Weather Bureau lightning study will probably be available in June, 1931. It may be stated that the Weather Bureau fire research program in this region is still somewhat cramped for lack of funds.

Insects

Serious destruction of merchantable timber by bark beetles of the genus Dendroctonus constitutes the most serious entomological problem confronting the Council at this time. As a result practically the entire investigative force of the Coeur d'Alene Forest Insect Field Station has been concentrated upon the development of more efficient control measures and the improvement of those now in use. In the prosecution of the study it has been necessary to consider such phases as the seasonal history of the insect responsible for the destruction, its relation to the parasitic and predacious insects found in association with it, the role of insectivorous birds, the relation of climatic conditions to insect development, the reaction of the insect to certain external stimuli, the physiological and chemical properties of the host, in fact, a complete study of the insect in relation to environmental factors.

As a tree once successfully attacked by bark beetles cannot be saved, control measures are directed toward the destruction of the insect broods within the infested trees in order to prevent their emergence and subsequent attack of other trees. In attempting to improve the direct control measures now in practice the possibilities of destroying the insect broods through the creation of abnormal subcortical conditions, solar heat, traps, poisoning, etc., were all thoroughly tested in both lodgepole and white pine stands. Poisoning methods were given a rather thorough test in 1930. A fairly rapid and inexpensive method of cutting a shallow saw kerf through the bark and then tacking a flared, tin, cup-like collar around the tree below the cut, to hold the poisonous solution, was developed. But although this method worked very satisfactorily as far as applying the solution was concerned it was found that the tree would not absorb the liquid uniformly. A short distance above the saw kerf the absorption was very irregular, usually following a strip up one side of the bole in a manner difficult to explain. Though the insects were destroyed wherever the poison was absorbed further study is necessary in order to bring about a uniform assimilation of the solution before the method can be used effectively as a control measure. Some further work along this line is planned for the season of 1931.

The development of more efficient control methods in the white pine type is particularly important as the cost per tree, varying from $3.50 to $4.50 is considerably higher than in lodgepole. The method of spring control now in use for infested white pines is to fell the tree and remove the bark from the infested portion. It was found that following this operation the insects were rapidly destroyed by ants, mice, squirrels, shrews, etc., making this method very successful. Many of the nearly formed adults, possessing powers of locomotion are able to protect themselves by crawling down into the debris for concealment and these are able, in spite of abnormal conditions, to complete their development, attack and produce fertile eggs.

Successful progress has been made in the study of parasitic insects. The objective of this study was the correlation of artificial control measures with the seasonal histories of the most beneficial insects in order to take advantage of these natural agencies of control in combatting future epidemics. Two primarily important insects have been found, a Coeloides sp. (Hymenoptera) and a Dipteruous (Mediterus aldrichi), both of which are very destructive to the larval stages of the mountain pine beetle. Though these insects are found in both white pine and lodgepole pine, their seasonal histories are quite different. On lodgepole pine these parasitic insects attack the overwintering brood of the mountain pine bettle late in May and June, so that the adoption of fall control is advantageous as it protects these beneficial insects. But in white pine these parasites attack both the overwintering and summer broods making fall control of very little, if any, advantage. Though this study has been fairly well completed there are several important phases requiring additional study.

The biology of the mountain pine bettle was rather intensively studied during the past season. A point of unusual interest is the emergence of parent adults in five or six weeks following the first attack, and the re-attack of another tree. This may or may not prove to be a normal condition and its economic importance is yet to be determined.

All control projects for the suppression of barkbeetle have been and still are regarded in the light of experiments with the idea of improving the methods in present use. Valuable information relative to the potential of flights, multiplication, etc., as well as in the administration and supervision of control work, has resulted from these studies. It is very clear that more emphasis must be given to the quality of the work performed. The need for more trained and exacting supervision is very evident. The 1930 survey on the Beaverhead shows an increase of 60 per cent over the 1929 attack which means that, in spite of the expected marked reduction in the percentage of increase, the devastating epidemic is continuing with an increase in its severity.

During the past season an intensive spraying operation was instituted against the spruce budworm in the Cody Canyon to determine if the lead arsenate spray, successfully used against the Gypsy moth in the eastern United States, would be effective in the control of this insect. Though some success was attained the work cannot be considered as satisfactory. This is due to the peculiar feeding habit of the insect in attacking the

base of the new needle. It is difficult to reach this portion of the foliage with sufficient poison to be fatal. Furthermore, considerable difficulty was experienced in securing a good coverage upon the new growth which does not seem to possess the adherent qualities of the old needles. As a result of this work it is evident that the spruce budworm will prove to be an insect difficult to control with standardized spraying methods. The problem demands thorough fundamental study.

Mr. Melrose described some experiments in airplane dusting for spruce budworm which are apparently getting good results.

Additional field and laboratory work have been conducted on the parasites and predators of the fir tussock moth. These parasites have been so active during the past season that the epidemics in Nevada, Central Idaho and northeastern Washington have been very materially reduced. A new predator (Calosoma sycophanta) has been liberated at Northport, Washington, in the hope that a colony of these very beneficial insects can be established.

Satisfactory progress has also been made on two minor projects conducted by the Forest Insect Station, one dealing with the interrelation of fires and insects, the other following the defoliation of yellow pine by the severe freeze that occurred in December, 1924. In both cases the insect attack is regarded as secondary.

Two additional projects will be added in 1931, one a study of the Doublas fir beetle (Dendroctonous pseudotsugae) and the other a study of the Oregon pine engraver (Ips oregoni).

Products

There are a total of fifteen projects under this head, five carried by the Regional Office of Forest Products, four by the University of Idaho Forest School and six by the University of Montana Forest School. This list of projects includes studies of logging and milling practices, utilization, woods waste, tie, pole and post preservation, etc. These studies are almost all devoted to solving immediate and practical problems of dollars and cents value to the lumberman, though in certain studies of wood chemistry and moisture content the work is necessarily of a fundamental character.

Logging and Milling

The five projects carried by the Office of Forest Products are each really fields of work involving a number of separate investigations. For example, the logging and milling studies conducted during 1930 include tree to green chain studies in western yellow pine, three of which have now been completed, and a study of depreciation in fire damaged white pine as well as the A. C. M. relogging study described under Mensuration.

The tree to green chain studies have already furnished information of great value and will be published upon as quickly as possible. They show, for example, based on the Pondosa pine values ($23.50 per M) for the

first half of 1930 and production costs as of 1929, that a 20-inch western yellow pine cannot be handled with any return for stumpage, interest or profit. Trees below this size are handled at a loss reaching $8.50 per M for 14-inch trees, and larger trees at a profit reaching $8.20 per M in 36-inch trees with the margin widening fast in trees above this size.

The effects of height on value is shown in the following table:

EFFECT OF HEIGHT ON VALUE

Western Yellow (Pondosa) Pine

D.B.H. of Tree (ins.)	Logs per Tree	Value per M Lbr. Tally	Spread Between Heights	Value per M of Average Tree Each Diam. Class	Spread Between Diam. Classes
14	2	$ 20.76			
14	4	$ 22.28	$1.52	$21.77	$ 1.77
16	3	$ 21.50			
16	5	$ 27.63	$6.13	$23.54	$ 1.02
20	4	$ 23.82			
20	6	$ 26.79	$2.97	$24.56	$ 4.07
24	4	$ 28.08			
24	6	$ 28.81	$0.73	$28.63	$ 4.56
30	4	$ 30.22			
30	7	$ 37.64	$7.42	$33.19	$ 2.44
33	4	$ 26.72			
33	6	$ 31.76	$5.04	$30.75	

The question of whether top logs of the same dimensions cut from trees of different diameters produce the same amount of quality lumber is another interesting point on which the tree study furnishes information. This study brings out the following facts:

(1) There was an increase in the value per M of the 7" top logs in trees 12" up to 14" in d.b.h., and then a decrease in the value in trees up to 18", the largest tree from which a 7" top log was cut.

(2) Top logs 8" in top diameter increased in value in trees 15" to 18" d.b.h., and then decreased rapidly in value in the 19" to 25", trees.

(3) Top logs 9" in diameter decreased in value in trees 12" to 15" in d.b.h. and then increased rapidly in value in trees up to 25", the largest tree from which they were cut.

(4) Top logs 10" in diameter decreased in value in trees 16" to 19" in d.b.h. and then increased rapidly in value in trees up to 25". No 10" top logs were cut from trees larger than 25" in d.b.h.

(5) Butt logs 12", 14", 15" and 16" in top diameter increase rapidly in value from the smallest tree in which they occur up to the largest tree from which they can be cut.

(6) The taper varies greatly in logs of the same dimensions and position in the tree cut from trees of different diameters. The amount of lumber that can be cut from a log of given size increases rapidly with the taper.

A very interesting comparison of long log versus tree length tractor logging was also made from the tree studies. Since the two methods include practically all of the tractor logging in western Montana, this comparison is of considerable interest to yellow pine operators. Felling, limbing and topping trees plus bucking at the landing and felling, limbing and bucking into long logs in the woods were compared. On a tree-diameter basis, the volume output per effective hour is all in favor of the long log system. This is also true from a cost standpoint. For instance, trees 24" d.b.h. can be felled, limbed, and bucked into long logs in the woods for 56 cents per M contrasted to 68 cents per M for felling, limbing, and topping plus bucking at the landing. The difference is 12 cents per M. The volume difference in output for 24" trees is 130 feet per effective hour in favor of the long-log system. The skidding comparison of the two methods shows the long-log system up to a better advantage, but not so decisively as in the previous comparison. It is apparently cheaper to use the tree-length system of skidding for trees from 12" to 18" in size, but above that diameter the long-log system is cheaper. Since the average tree in most of our yellow pine stands is over 18" d.b.h. and the majority of trees moved are over 18" d.b.h. it appears that the long-log system of tractor logging is the more economical.

The results of the study of depreciation in fire damaged white pine have already been presented in THE TIMBERMAN. Two of the outstanding findings in this study were:

1. Green-cut sound (check) logs in this study yielded an average of 7 per cent No. 4 and 5 common lumber. One-year-old fire-killed logs (sound except for fire defect) yielded 11 per cent. Two-year-old fire-killed logs (sound except for fire defect) yielded 24 per cent. Two-year-old fire-killed logs yield more than three times the normal amount of No. 4 and 5 common lumber.

2. Two-year-old fire-damaged logs lost 16 per cent of their lumber-sale value. One-year-old fire-damaged logs lost 10 per cent of their lumber-sale value. These figures are based on average Western Pine Manufacturers' Idaho white pine prices for 1927 minus deductions for normal degrade and shrinkage from green chain to car. Using the same figures as a basis the following tabulation shows the selling-value loss by log runs for one and two-year-old fire-damaged logs.

SELLING VALUE LOSS BY LOG RUNS

Log Class	Number of Logs per Thousand Feet Log Scale												
	4	5	6	7	8	9	10	11	12	13	14	15	16
2-year $ Value	6.30	6.40	6.50	6.65	6.80	6.85	6.95	7.00	7.00	7.05	7.00	6.95	6.90
2 yr. %	15	15	15	15	16	16	16	16	16	16	16	16	16
1-year $ Value	3.70	3.80	3.90	4.05	4.15	4.30	4.45	4.55	4.75	4.90	5.10	5.30	5.50
1 yr. %	9	9	9	9	9	10	10	10	11	11	12	12	12

Further work in the general field of logging and milling studies will involve the compilation of a series of trade journal articles on the three yellow pine tree studies and a similar study in western white pine if the necessary co-operation can be obtained. The Experiment Station is very anxious to co-operate in this work but so far funds have not been available. A tree study in the larch-fir type will be made as soon as time permits.

Utilization and Waste

The Office of Forest Products carries six studies under this head. An article on the chute depreciation study has already been published in THE TIMBERMAN. This study contributed directly to our knowledge of value losses from chute damage. It was found that the volume loss log scale ranged from 4 to 6 per cent depending on the size of timber. The small logs suffered the greatest value loss as well as the greatest volume loss per thousand feet of logs handled. Value losses based on May, 1929, white pine prices are as follows:

	Logs Per M							
	7	8	9	10	11	12	13	14
Value loss Per M	$ 1.24	1.41	1.57	1.72	1.89	2.05	2.21	2.37

The woods waste inventory has been partially compiled and some interesting preliminary information is given below:

WHITE PINE TYPE

WOOD MATERIAL PER ACRE LEFT AFTER LOGGING

Age Class	Feet Board Measure: Volume Logged Per Acre--Gross W.P.	Volume Logged Per Acre--Gross Total	*Volume Left Per Acre--Gross W.P.	*Volume Left Per Acre--Gross Total	Merch. Saw logs W.P.	Merch. Saw logs Tot.	Waste Net Stumps: Ave. Hght. Ins. Sound White Pine	Waste Net Stumps: % of Stumps Defective W.P.	Waste Net Stumps: Merch. Waste High Stumps W.P.	Waste Net Stumps: Merch. Waste High Stumps Tot.	Waste: Total Board M.	Waste: Total Cubic F.
80-100	20400	27300	1700	4800	500	700	16.4	19.6	340	460	1160	413
101-120	16400	27300	500	5500	400	800	15.3	38.9	240	540	1340	518
141-160	15000	18700	2100	3900	280	440	10.6	26.2	145	230	670	1080
200+	13500	18800	700	18300	190	620	11.9	50.3	105	225	850	1367
				**								
All	17800	25300	1134	10600	400	820	14.5	37.6	215	410	1230	1117

* 8" D.B.H. and larger.
** 30% defective.

Preliminary compilations of existing data in the logbucking for grade study indicates the numerous ways in which this project may make contributions of value to the lumber industry. One interesting fact is that out of tree studies involving a total volume of 500 M to 600 M feet not a single sound yellow pine butt log over 27 inches was found. The following table shows the effect of fire on log values for a few representative diameters:

16" Grade 1 Logs

Taper Inches												
2"			4"			5"			8"			
Value Per Sound Log	Fire Dam.	Loss Per Log	Value Per Sound Log	Fire Dam.	Loss Per Log	Value Per Sound Log	Fire Dam.	Loss Per Log	Value Per Sound Log	Fire Dam.	Loss Per Log	
$ 5.89	3.71	2.18	6.51	4.67	1.84	7.72	7.20	.52	6.43	3.90	2.53	

18" Grade 1 Logs

4"			5"		
$11.01	9.12	1.89	11.18	8.35	2.83

20" Grade 1 Logs

3"			4"			5"		
$12.58	7.19	5.39	16.50	11.93	4.57	16.38	11.68	4.70

24" Grade 1 Logs

4"			8"		
$26.32	10.53	15.79	19.32	8.15	11.17

The priority given to the depreciation study of fire-killed white pine prevented compilation of data in the breakage in felling study. A new study in the utilization of small tie sawmills has not yet progressed to a point where any definite results may be stated. No work was done on the depreciation of bug-killed white pine as the Holstead Mill near Troy, Montana, did not operate and no other suitable location could be found.

The University of Idaho carries one project on utilization and wood waste. The object of this work is to develop new and better uses for woods and wood products native to Idaho, including a study of chemical derivatives from wood, wood waste, slash and other parts of the tree. Six articles, each covering a different phase of this work, have already been published. One of the most interesting phases involves a study of the fungi which produce chemical by-products of commercial value. Another brief study dealt with the thermal conductivity of compressed Douglas fir, in the course of which a simple method was developed of binding ground bark into solid cylinders. Using this lead, the Clearwater Timber Company worked out a method of heating and pressing fine shavings into briquets which burn without ash and without clinkers. These briquets now sell in Lewiston, Idaho, at $10 per ton, and local orders are taking the entire present output of the Company's mill.

Preservation

The regional wood preserving studies being carried on in co-operation with the Forest Products Laboratory include a number of experimental tests to determine the durability of treated and untreated woods in actual service and the efficiency of different preservatives when applied by different methods. These tests include treatments with creosote, creosote-petroleum mixtures, zinc chloride, sodium fluoride and various forms of Anaconda Wood Preservative. Information resulting from actual experience in treating various kinds of wood growing in this region has been used as the basis for present specifications for the treatment of timbers in Forest Service improvement work, the design of open-tank apparatus and recommendations to the public. At present there are 24 service-test projects in the Region which require periodic inspection and report.

One interesting test begun in 1913, to determine the suitability of pitch-treated lodgepole pine trees for poles, was published in 1930. It was found that lodgepole pine poles, treated by barking the living trees have an average life in the Montana region of about eight years. Untreated lodgepole pine poles will give an average life of about seven years. This short increase in life may be enough to pay for the cost of treating the poles, but thoroughly butt-creosoted poles treated by the open tank method would undoubtedly give a longer life and prove more economical. The pitch treatment, therefore, has little to recommend it.

Properties

The Regional Office of Forest Products, working in co-operation with the Forest Products Laboratory, has made detailed studies of the properties and characteristics of the wood of several of the Region's little-used species (western larch, white fir and lodgepole) which will

assist consumers in determining the suitability of the species for specific uses. The western larch study is now in manuscript form. The Region I contribution to the white fir study and the lodgepole pine bulletin are still to be prepared.

The remaining projects in products research are carried by the Forest Schools, each of which is making a real contribution to our knowledge of wood properties, seasoning, etc. Mr. Ramskill reported on a study at the University of Montana dealing with the electrical measurement of moisture in wood. This study is of a fundamental character and closely linked up with a study of the location and quantity of moisture in wood at various stages of the seasoning process to determine the governing factors and their relative influence. Dr. Hubert reported on a project at the University of Idaho also dealing with the movement of moisture in wood, but chiefly from the standpoint of its effect on decay. Both studies are progressing satisfactorily but must be continued for an indefinite period before results will be available.

The University of Montana is conducting a study of dry kiln practice, in co-operation with the White Pine Sash Co., a Missoula manufacturer, with the particular object of eliminating brown stain in western yellow pine during kiln drying. This investigation has led to several changes in dry kiln procedure resulting in material reduction of the brown stain injury. The results are not yet entirely satisfactory, however, and some further work is to be done.

The University of Idaho Forest School has initiated a study of the production of useful products from mill waste, woods waste and second quality timber. This work, which was begun in October, 1930, will include a study of the chemical properties and structure of wood constituents such as lignin and cellulose and the application of this knowledge to the utilization of wood constituents and the production of other substances from them. Several other products studies are underway at both Schools, but no results are ready for discussion at this time.

A study of the diagonistic characteristics of the woods of the genus Abies and a key based upon their identification characteristics has been finished at the University of Idaho and will be ready for publication shortly.

Grazing

There are a total of 13 projects in this field all conducted by the Regional Office of Grazing, two in co-operation with the University of Montana and one in co-operation with the University of Idaho. This work is carried entirely by contributed time, many of the projects being handled by local forest officers under the supervision of the Regional Office. The amount of time and money that can be spared for this work is pitifully small in view of the importance of the grazing industry in Region I and the promising returns that adequate research offers. The Council strongly urges the expansion of grazing research in this Region.

Most of the projects now under way are continuing, long-time projects which have been reported on before in some detail. They include

studies in growth, development and extension of range plants, artificial reseeding of ranges, stock handling, range carrying capacity, and in the eradication of poisonous plants. Two projects, dealing with the eradication of Delphinium and Hypericum perforatum, respectively, were completed in 1930. The results indicated that sodium chlorate properly applied is an effective killing agent with calcium chlorate somewhat less so. The spraying method of treatment gave best results.

Ecology

The selection and designation of natural areas probably represents the most important effort at present in the field of ecology. This work has been described in a previous section of the report. The urgent need for immediate action in setting aside carefully selected areas for future ecological study is clearly recognized and selections are being made as rapidly as limited facilities permit.

The phenological project in which 26 observers, almost all on national forests, are recording certain selected biotic events as leafing, pollination, etc., has just completed its third year. This project is now undoubtedly on a firm basis. Most of the observers are systematic and thorough, and although some additional training is necessary the observational records being taken are undoubtedly a real contribution to this phase of botanical knowledge. The Experiment Station has recently finished a very brief progress report covering the first three years' records and the forms have been revised and simplified to make future work somewhat easier. This project is to be continued for an indefinite period.

Establishment of an arboretum at the Priest River Branch Experiment Station is now well underway with thorough preparatory work accomplished in the way of mapping, topography, soil and site conditions (wet, moist, medium and dry sites), considerable cleaning up and disposal of fire-killed debris, poisoning of gophers, and planting of initial blocks of some native and exotic species. The area includes over a hundred acres and has just been fenced to exclude horses and cattle.

Mr. Larsen's report entitled "Forest Types of the Northern Rocky Mountains and Their Climatic Controls" was published in the October, 1930, issue of Ecology. This concludes work on one of the old projects upon which Larsen was engaged before he left the Experiment Station some years ago. His remaining report in this field of work, which is to be called "Physical Factors of Site in Northern Idaho" is still to be completed.

The University of Montana continues its investigations of the site requirements of western yellow pine and a study of root competition and tolerance of western yellow pine. Progress was made on both studies during 1930, but there are as yet no results to report.

Silvics

There are no active projects under this field. The Experiment Station still intends to publish a bulletin pertaining to the silvics and

management of western white pine based on twenty years of study and observation and it is hoped that Messrs. Weidman and Haig will be able to start work on this within the next calendar year. A manuscript by Mr. Larsen entitled "Conifers of the Northern Rocky Mountains" was submitted to the Branch of Research a year or more ago.

Dendrology

The most important event in this field has been the publication of the late Dr. Kirkwood's monograph "Trees and Shrubs of the Northern Rocky Mountain Region." This publication, by an authority in his field, has been eagerly awaited by botanists and dendrologists in this region.

No other work is being carried or planned at present in the field of dendrology.

Economics

The Regional Office of Forest Products carried as usual a number of studies and canvasses in this field, about 30 per cent of its time being spent in this manner. The data collected include figures on the production of lumber and timber products within the Region, their cost of production, the prices both wholesale and retail at which they sold, and their distribution. Such information is necessary for a proper management of the National Forests and an understanding of the industry in general.

The lumber and timber products census was completed early in 1930 with a total of 408 sawmills and 212 miscellaneous timber operators being canvassed in addition to 171 returns from south Idaho, the editing and tabulation of which were handled by Region I. The preliminary returns for Idaho show a 1929 cut of more than a billion board feet, a gain of 5.2 per cent over the 1928 cut, and a total cut exceeded only in 1923 and 1925. The Montana figures for 1929 show a slight gain over the 1928 cut. With an average annual cut of approximately 388 million board feet for the past five years' lumber production in Montana has been maintained at a very uniform level since 1924.

The usual annual collection of logging and manufacturing costs in the Region was made in 1930. Such cost figures are not only of interest to co-operators for purposes of comparison but are used in arriving at production cost figures in many lines of Products and Logging Engineering work. In 1930 this study was expanded somewhat to include more detailed logging costs. Photostat copies of these detailed costs are sent to some 30-odd co-operators within 30 days after collection.

During 1930 the Regional Office of Lands completed the economic use survey of 60,000 acres of publicly owned and tillable land on the Custer National Forest, carried administratively over the last several years.

The University of Idaho has likewise completed an economic survey from a forest standpoint of Benewah County, Idaho. The report will probably be finished and published in 1931.

Two research projects in forest economics are also being carried by the University of Montana. One deals with forest taxation and the other with a study of the functioning, place and efficiency of co-operative protection agencies. Both projects are active and a preliminary report on the co-operative protective agency study has already been made.

ARTICLES AND PUBLICATIONS BY THE EXPERIMENT STATION

Submitted for Publication

1. Timber Growing and Logging Practice in the Northwestern Yellow Pine Region. R. H. Weidman. U.S.D.A. Bulletin.

2. A Five Year Record of Lightning Storms and Forest Fires in the Northern Rockies. H. T. Gisborne. Monthly Weather Review.

3. Conifers of the Northern Rocky Mountains. J. A. Larsen. U.S.D.A. Circular.

4. The Stocked Quadrat Method of Sampling Reproduction Stands. I. T. Haig. Journal of Forestry.

5. Stand Tables for Second-Growth Western White Pine. I. T. Haig. Northwest Science.

Published in 1930

1. Forest Fire Research. H. T. Gisborne. Scientific Monthly Vol. 31: 76-80. July 1930.

2. A Quarter Century of Silviculture in the Western White Pine Type. I. T. Haig. Forestry Kaimin of University of Montana, 1930.

3. Forest Types of the Northern Rocky Mountains and Their Climatic Controls. J. A. Larsen. Ecology Vol. 11: 631-672, October, 1930.

4. Investigations in Weed Control by Zinc Sulphate and Other Chemicals at the Savenac Forest Nursery. W. G. Wahlenberg. U.S.D.A. Tech. Bul. 156. January, 1930.

5. Experiments in the use of Fertilizers in Growing Forest Planting Material at the Savenac Nursery. W. G. Wahlenberg. U.S.D.A. Cir. 125.

6. Effect of Ceanothus Brush on Western Yellow Pine Plantations in the Northern Rocky Mountains. W. G. Wahlenberg. Jour. Agr. Research 41: 601-612, October, 1930.

7. After Advertising and Mergers - Then What? H. T. Gisborne. Editorial, The Timberman, August, 1930.

In Preparation or Proposed for 1931

1. Sources of regeneration Following Fires in the Western White Pine Forest. R. H. Weidman. Article.

2. A Silvicultural Study of Western White Pine. R. H. Weidman and I. T. Haig. U.S.D.A. Bul.

3. Results of Thinning Experiments in the Western White Pine Type. R. H. Weidman. Progress Report.

4. The Determination of Hour Control for Adequate Fire Protection in the Major Cover Types of the Northern Rocky Mountain Region. H. T. Gisborne and L. G. Hornby. U.S.D.A. Bul.

5. Atmospheric Indices of Forest Inflammability. H. T. Gisborne. Article.

6. Yield, Stand and Volume Tables for Second-Growth Western White Pine. I. T. Haig. U.S.D.A. Tech. Bul. (In manuscript.)

7. Reproduction and Residual Growth on Cut-over Areas in the Western White Pine Type. I. T. Haig. Final Report.

8. Comparative Timber Yields. I. T. Haig. Article. (In manuscript.)

9. Recovery, Growth and Treatment of Understory Hemlock Released by Logging in the Western White Pine Type. I. T. Haig. Article. (In manuscript.)

10. Seed Germination During Natural Storage in Duff. R. H. Weidman and I. T. Haig. Note.

11. Growth and Yield of Western White Pine. I. T. Haig. Article. Submitted to Timberman, May 1931.

12. The Effect of Stand Composition on Yield in the Western White Pine Type. I. T. Haig. Article.

13. The Effect of Stand Composition, Site and Other Factors on Tree Volume in the Western White Pine Type. I. T. Haig. Article.

ARTICLES AND PUBLICATIONS BY THE R-1 PRODUCTS OFFICE

Submitted for Publication

1. Properties and Use Bulletin for Western Larch. R. P. A. Johnson and M. Bradner. Dep't. Bulletin.

2. Logging Output Bulletin. M. Bradner. Dep't. Bul.

3. Residual Wood After Logging in the Western White Pine Type. I. V. Anderson. Trade Journal Article.

Published in 1930

1. Log Damage on Gravity Chutes. I. V. Anderson. Trade Journal Article.

2. Fire Damaged Idaho White Pine Logs - What is the Loss? M. Bradner and I. V. Anderson. Trade Journal Article.

In Preparation for Publication 1931

1. Residual Wood After Logging in the Western Yellow Pine Type. I. V. Anderson. Trade Journal Article.

2. Residual Wood After Logging in the Larch-Douglas Fir and Lodgepole Pine Types. I. V. Anderson. Trade Journal Article.

3. Breakage Losses in Felling Important Trees of the Inland Empire. I. V. Anderson. Trade Journal Article.

4. Region 1 Contribution to White Fir Bulletin. M. Bradner. Dep't. Bulletin.

5. Properties and Use Bulletin for Lodgepole Pine. C. N. Whitney. Dep't. Bulletin.

6. Tree Values and Production Cost for Montana Western Yellow Pine. Recommendations for Selective Logging in Western Montana. M. Bradner. Trade Journal Article.

7. A Second Cutting of Yellow Pine in Western Montana. Results of Accidental Selective Logging Forty Years Ago. I. V. Anderson. Trade Journal Article.

ORDER OF EXPERIMENT STATION EFFORT PLANNED FOR F. Y. 1932

The following tabulation shows the relative order of effort to be devoted to projects and lines of work by the Experiment Station for the fiscal year 1932:

Lines of Work and Projects	*Proposed Expenditures
Fire Protection	
Statistical & field study of hour control (Pf, D-1)	$10,500
Fire damage (Pf, A-1)	5,400
Weather and fuel relationships (Pf, B-5)	3,700
Fire weather forecasting (Pf, C-7)	1,300
Lightning and forest fires (Pf, B-1)	700

Methods of cutting--western white pine (Mc-102)	3,400
Management--Priest River Exp'tal. Forest	2,900
Reproduction--western white pine (Mr-102)	2,500
Tree study--western white pine bulletin (Ts-102)	1,400
Yield--western white pine (ME-102)	700
Thinning--western white pine (Mt-102)	700
Management	
Western yellow pine timber growing (M-Reqts.)	500
Selection of proposed experimental forests	500
Arboretum	400
Phenology	300
Total	$34,900

*The proposed project expenditures include overhead prorated over all the projects.

The amount to be devoted to fire protection research will be $21,600, to silvicultural research $9,900, and to the management and selection of experimental forest $3,400.

EXPERIMENT STATION STAFF F. Y. 1932

R. H. Weidman	Director
H. T. Gisborne	Silviculturist
I. T. Haig	Associate Silviculturist
_____ _____	Associate Silviculturist
_____ _____	Junior Forester
J. B. Thompson	Junior Forester
Anna J. Bramseth	Clerk

EXPERIMENT STATION BUDGET F. Y. 1932

	SI	S&E R-1	Imp.
Salaries (permanent staff)	$21,180		
Expenses (permanent staff)	2,400		

Sal. and exp. (other forest officers)	1,800		
Sal. and exp. (field assistants)	2,350		
Salaries (computers)	3,840		
Purchase of autos	1,300		
Maintenance of autos	600	75	
Supplies and equipment	1,230	140	
Freight, express and drayage	200	60	
Maintenance Branch Station			545
	$34,900	$625	$545

LIST OF RESEARCH PROJECTS TO BE CARRIED IN 1931

By REGION I and NORTHERN

ROCKY MOUNTAIN FOREST EXPERIMENT STATION

Office of Forest Products

(1) Logging and Milling Studies
  (a) Tree to Green Chain Studies
  (b) Depreciation in fire damaged white pine
  (c) A. C. M. relogging study

(2) Woods Utilization Studies
  (a) Wood Waste
  (b) Breakage
  (c) Chute depreciation
  (d) Log bucking for grade and size of lumber
  (e) Utilization in small tie mills

(3) Durability of Woods in Service

(4) Little Used Species Studies

(5) Logging Output Studies

(6) Lumber Production Census

(7) Prices of Forest Products

(8) Distribution

(9) Logging and Manufacturing Costs

Office of Management

(1) Encroachment of yellow pine reproduction on grasslands

(2) Increment after cutting in western yellow pine

(3) Increment after cutting in western white pine

(4) Increment after cutting in lodgepole pine

(5) Volume table for eastern Montana Douglas fir.

Office of Operation

(1) Adaptation and development of radio telephone equipment for field use

(2) Use of small tractors for fire-trench construction

(3) Use of explosives for fire-trench construction

(4) The relation of the occurrence of lightning fires to underlying geological formations

(5) Adequate Fire Control

(6) Aerial Photographic Mapping

Office of Planting

(1) Survival of planting on grassy bottom lands

(2) Yield and germinative energy of western yellow pine seed from various age classes

(3) Time of ripening of seed

(4) Yield and germinative energy of western white pine seed from various age classes

(5) Spacing in yellow pine plantations

(6) Spacing in white pine plantations

(7) Source of Englemann Spruce seed

Office of Range Management

(1) Range carrying capacity - Custer National Forest

(2) Range carrying capacity - Helena National Forest

(3) Artificial reseeding of ranges

(4) Methods of handling stock

(5) The seed factor in the management of ranges

(6) The growth, development and extension of range plants

Experiment Station

(1) Methods of cutting in western white pine forests

(2) Reproduction after cutting and forest fires in western white pine forests

(3) Methods of thinning western white pine stands

(4) The growth and yield of western white pine stands

(5) The growth and yield of western larch, Douglas fir and western red cedar in the white pine type

(6) Lightning in relation to forest fires

(7) Relation of weather to forest inflammability

(8) Fire-weather forecasting

(9) Determination of the factors involved in fire damage

(10) The speed and strength of attack necessary to attain successful fire control in the important timber types of Region I

(11) A silvicultural study of western white pine

(12) Growth and composition of virgin overmature western white pine stands

(13) Test of racial varieties of western yellow pine in northern Idaho

(14) Testing exotics and species native elsewhere in America for adaptability in northern Idaho

(15) Phenological observations on forest trees and subordinate vegetation to obtain definite knowledge on time and conditions of the seasonal vegetative events

(16) Development of the 6000-acre experimental forest at Priest River